Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (Currently Amended): Multi-user detection method with elimination of interference between users, each user transmitting modulated data in the form of symbols on a transmission channel, each transmission channel (k) comprising at least one propagation path (i) and each propagation path arriving at an array of reception antennae (ℓ) according to a direction of arrival ($\theta_{i,k}$), the method comprising at least one sequence of steps for each user (k), [[characterised in that]] wherein each sequence comprises:

(a) a reception step [[(600_k,700_k,800_k,800,900)]] decomposing each antenna signal into filtered signals ($x_{\ell,i,k}$) issuing from [[the]] different paths (i) of the [[said]] user (k) and combining the [[said]] filtered signals by [[means of]] scaling the filtered signals with a first plurality of complex coefficients ($b_{\ell,i,k}, c_{i,k}$) in order to form an estimation (z_k) of [[the]] a signal transmitted by the user;

(b) a step of estimating [[(670_k,770_k,870_k,870,970)]] the contribution ($(x_{\ell,k})\ell=1..L$) of the user to the signals received by the [[different]] array of reception antennae from the [[said]] estimation of the signal transmitted and a second plurality of complex coefficients ($u_{i,k}$, $w_{\ell,i,k}$) obtained from the [[said]] first plurality of complex coefficients;

(c) a step of eliminating interference [[($680_{k'}$,780_k,880_k,880,980)]] subtracting from the antenna signals the contribution estimated at step (b) in order to obtain cleaned antenna signals;

the cleaned antenna signals supplied by at least one first sequence being used as antenna signals by at least one second sequence.

Claim 2 (Currently Amended): Multi-user detection method according to Claim 1, [[characterised in that]] wherein the first plurality of complex coefficients comprises a first set of complex coefficients ($b_{\ell,i,k}$) and a second set of complex coefficients ($c_{i,k}$) and [[in that]] the filtered signals ($x_{\ell,i,k}$) are subjected to a channel formation step [[(420_k)]] in order to form signals of paths ($y_{i,k}$) by [[means of]] scaling the path signals with the [[said]] first set, the [[said]] path signals then being linearly combined [[(440_k)]] by [[means of]] scaling the path signals with the [[said]] second set in order to supply the [[said]] estimation (z_k) of the signal transmitted, the coefficients of the first set being adapted so as to minimise a plurality of first error signals ($\epsilon'_{i,k}$) between a reference value (q_k) of the transmitted signal and the [[said]] path signals ($y_{i,k}$), the coefficients of the [[said]] second set being adapted so as to minimise a second error signal (ϵ''_k) between the [[said]] estimation (z_k) and the [[said]] reference value.

Claim 3 (Currently Amended): Multi-user detection method according to Claim 2, [[characterised in that]] wherein the [[said]] second plurality ($w_{\ell,i,k}$, $u_{i,k}$) of coefficients comprises a first set of complex coefficients ($w_{\ell,i,k}$) and a second set of complex coefficients ($u_{i,k}$), the coefficients ($w_{\ell,i,k}$) of the [[said]] first set of the second plurality being obtained from the arguments of the coefficients ($b_{\ell,i,k}$) of the first set of the first plurality and the coefficients ($u_{i,k}$) of the [[said]] second set of the second plurality being obtained from coefficients ($c_{i,k}$) of the [[said]] second set of the first plurality.

Claim 4 (Currently Amended): Multi-user detection method according to Claim 3, [[characterised in that]] wherein the coefficients ($u_{i,k}$) of the [[said]] second set of the second

plurality are obtained by conjugation of the coefficients ($c_{i,k}$) of the second set of the first plurality.

Claim 5 (Currently Amended): Multi-user detection method according to Claim 3 or 4, [[characterised in that]] wherein the coefficients ($w_{\ell i,k}$) of the [[said]] first set of the second plurality are obtained from a linear regression on the arguments of the coefficients ($b_{\ell i,k}$) of the first set of the first plurality.

Claim 6 (Currently Amended): Multi-user detection method according to one of Claims 2 to [[5, characterised in that,]] 4, wherein at the first sequence,

the coefficients ($b_{\ell i,k}$) of the first set of the first plurality are initialised by $b_{\ell i,k}(0)=\delta(\ell-\ell o),\forall i$ where δ is the Dirac symbol, ℓo is an antenna number;

and [[in that]] the coefficients ($c_{i,k}$) of the second set of the first plurality are initialised by $c_{i,k}(0)=c,\forall i$ where c is a given complex coefficient.

Claim 7 (Currently Amended): Multi-user detection method according to one of Claims 2 to [[5, characterised in that,]] 4, wherein at the first sequence,

the coefficients ($b_{\ell i,k}$) of the first set of the first plurality are initialised by $b_{\ell i,k}(0)=\exp(-j(\hat{v}_{i,k}(0)+2\pi d/\lambda \cos\hat{\theta}_{i,k}(0).(\ell-1)))$ and [[in that]] the coefficients($c_{i,k}$) of the second set of the first plurality are initialised by $c_{i,k}(0)=\hat{a}_{i,k}(0)$ where $\hat{\theta}_{i,k}(0)$, $\hat{v}_{i,k}(0)$, $\hat{a}_{i,k}(0)$ are respectively estimations of the directions of arrival, phase rotations and coefficients of attenuation for the different paths.

Claim 8 (Currently Amended): Multi-user detection method according to Claim 1, [[characterised in that]] wherein the first plurality of coefficients [[consist of]] includes a set of complex coefficients ($b_{\ell,i,k}$) and [[in that]] the filtered signals ($x_{\ell,i,k}$) are linearly combined (520_k) by [[means of]] scaling the filtered signals with said set in order to supply said estimation (z_k) of the signal transmitted, the coefficients of said set being adapted so as to minimise an error signal (ϵ_k) between the [[said]] estimation (z_k) and a reference value (q_k).

Claim 9 (Currently Amended): Multi-user detection method according to Claim 8, [[characterised in that the]] wherein said second plurality ($w_{\ell,i,k}$, $u_{i,k}$) of coefficients comprises a first set of complex coefficients ($w_{\ell,i,k}$) and a second set of complex coefficients ($u_{i,k}$), the coefficients ($u_{i,k}$) of the [[said]] second set of the second plurality being obtained by:

$u_{i,k}=g_{i,k}/g_k$ where $g_{i,k}$ is an estimation of the norm of the sub-vector $\bar{b}_{i,k} = \begin{pmatrix} b_{1,i,k} \\ b_{2,i,k} \\ \cdot \\ \cdot \\ b_{L,i,k} \end{pmatrix}$, L being the number of antennae in the array, where g_k is a mean of the $g_{i,k}$ values on the different paths, the coefficients ($w_{\ell,i,k}$) of the [[said]] first set of the second plurality being obtained from the arguments of the coefficients ($b_{\ell,i,k}$) of the [[said]] set of the first plurality.

Claim 10 (Currently Amended): Multi-user detection method according to Claim 8 or 9, [[characterised in that,]] wherein at the first sequence, the coefficients ($b_{\ell,i,k}$) of the [[said]] set of the first plurality are initialised by $b_{\ell,i,k}(0)=b\cdot\delta(\ell-\ell o),\forall i$ where δ is the Dirac symbol, ℓo is an antenna number and b a given complex coefficient.

Claim 11 (Currently Amended): Multi-user detection method according to Claim 8 or 9, [[characterised in that,]] wherein at the first sequence, the coefficients ($b_{\ell,i,k}$) of the [[said]] set of the first plurality are initialized by $b_{\ell,i,k}(0)=\hat{a}_{i,k}(0).\exp(-j(\hat{v}_{i,k}(0)+2\pi d/\lambda\cos\hat{\theta}_{i,k}(0).(\ell-1)))$ where $\hat{\theta}_{i,k}(0)$, $\hat{v}_{i,k}(0)$, $\hat{a}_{i,k}(0)$ are respectively estimations of the directions of arrival, phase rotations and coefficients of attenuation for the different paths.

Claim 12 (Currently Amended): Multi-user detection method according to one of [[the preceding claims, characterised in that,]] Claims 1-4 and 8-9, wherein for a given user (k), the interference is eliminated by subtracting [[(680_k,880_k,880,980)]] from the antenna signals of the contributions of all the other users.

Claim 13 (Currently Amended): Multi-user detection method according to Claim 12, [[characterised in that]] wherein each sequence comprises a step of estimating [[(610_k,710_k,810_k,810,910)]] the symbols transmitted from the estimation of the signal transmitted (z_k) in order to obtain first estimated signals ($\hat{s}k$), a step of demodulating [[(620_k, 720_k,820_k,820,920)]] the first estimated symbols ($\hat{s}k$) in order to obtain estimated data ($\hat{d}k$), a step of channel decoding [[(630_k,730_k,830_k,830,930)]] of the [[said]] estimated data followed by a channel recoding [[(640_k,740_k,840_k,840,940)]] and a remodulation [[(650_k,750_k,850_k,850,950)]] in order to obtain second estimated symbols ($\hat{s}'k$).

Claim 14 (Currently Amended): Multi-user detection method according to Claim 2 [[or 13,]] or 8 [[and 13, characterised in that]], wherein the reference value ($q^{(n)}{}_k$) for a transmitted signal, used at the second sequence or at a subsequence sequence (n), is the second estimated symbol ($\hat{s}'^{(n-1)}{}_k$) obtained for this signal at the previous sequence.

Claim 15 (Currently Amended): Multi-user detection method according to Claim 2 [[or 14,]] or 8 [[and 14, characterised in that]], wherein the reference value $(q^{(n)}{}_k)$ for a transmitted signal, used at the second sequence or at a subsequent sequence (n), is a combination of the first estimated symbol $(\hat{s}^{(n)}{}_k)$ obtained for this signal at the current sequence and of the second estimated symbol $(\hat{s}'^{(n-1)}{}_k)$ obtained for this signal at the previous sequence.

Claim 16 (Currently Amended): Multi-user detection method according to one of [[the preceding claims, characterised in that,]] Claims 1-4 and 8-9, wherein at the second sequence and at the subsequent sequences, the coefficients of the first plurality of a sequence are initialised from the values of coefficients of the first plurality of the previous sequence.

Claim 17 (Currently Amended): Multi-user detection method according to one of Claims [[1 to 11, characterised in that]] 1-4 and 8-9, wherein the users are classified in order of received power and [[in that]] the interference is eliminated by subtracting [[(780_k)]], one after the other, the contributions of the different users, commencing with the users with the highest received powers.

Claim 18 (Currently Amended): Multi-user detection method according to [[Claims 6 and]] Claim 17, [[characterised in that,]] wherein for each sequence of a user (k), the coefficients $(b_{\ell,i,k})$ of the first set of the first plurality are initialised by $b_{\ell,i,k}(0)=\delta(\ell\text{-}\ell o),\forall i$ where δ is the Dirac symbol, ℓo is an antenna number;

and [[in that]] the coefficients $(c_{i,k})$ of the second set of the first plurality are initialised by $c_{i,k}(0)=c,\forall i$ where c is a given complex coefficient.

Claim 19 (Currently Amended): Multi-user detection method according to [[Claims 7 and]] Claim 17, [[characterised in that,]] wherein for each sequence of a user (k), the coefficients ($b_{\ell,i,k}$) of the first set of the first plurality are initialised by $b_{\ell,i,k}(0)=\exp(-j(\hat{v}_{i,k}(0)+2\pi d/\lambda \cos\hat{\theta}_{i,k}(0).(\ell-1)))$ and [[in that]] the coefficients ($c_{i,k}$) of the second set of the first plurality are initialised by $c_{i,k}(0)=\hat{a}_{i,k}(0)$ where $\hat{\theta}_{i,k}(0)$, $\hat{v}_{i,k}(0)$, $\hat{a}_{i,k}(0)$ are respectively estimations of the directions of arrival, phase rotations and coefficients of attenuation for the different paths.

Claim 20 (Currently Amended): Multi-user detection method according to [[Claims 10 and]] Claim 17, [[characterised in that,]] wherein for each sequence of a user (k), the coefficients ($b_{\ell,i,k}$) of the [[said]] set of the first plurality are initialised by $b_{\ell,i,k}(0)=b\cdot\delta(\ell-\ell o),\forall i$ where δ is the Dirac symbol, ℓo is an antenna number and b a given complex coefficient.

Claim 21 (Currently Amended): Multi-user detection method according to [[Claims 11 and]] Claim 17, [[characterised in that,]] wherein for each sequence of a user (k), the coefficients ($b_{\ell,i,k}$) of the [[said]] set of the first plurality are initialised by $b_{\ell,i,k}(0)=\hat{a}_{i,k}(0).\exp(-j(\hat{v}_{i,k}(0)+2\pi d/\lambda \cos\hat{\theta}_{i,k}(0).(\ell-1)))$ where $\hat{\theta}_{i,k}(0)$, $\hat{v}_{i,k}(0)$, $\hat{a}_{i,k}(0)$ are respectively estimations of the directions of arrival, phase rotations and coefficients of attenuation for the different paths.

Claim 22 (Currently Amended): Multi-user detection method according to Claim 12, [[characterised in that,]] wherein the estimations of the transmitted signals of the users being considered [[to be]] comprise an estimations vector with K components where K is the

number of users, and the [[said]] vector is subjected to a transverse matrix filtering [[(805,905)]].

Claim 23 (Currently Amended): Multi-user detection method according to Claim 22, [[characterised in that,]] wherein the estimated symbols of the users being considered [[to be]] comprise a symbols vector with K components, the [[said]] symbols vector is subjected to a postcursor matrix filtering, [[(907)]] and the output of this filtering is subtracted, vector by vector, from the output of the transverse matrix filtering [[(905)]].

Claim 24 (Canceled).

Claim 25 (New): A multi-user detection system for elimination of interference between users, each user transmitting modulated data in the form of symbols on a transmission channel, each transmission channel (k) comprising at least one propagation path (i) and each propagation path arriving at an array of reception antennae (ℓ) according to a direction of arrival ($\theta_{i,k}$), the system comprising:

a receptor configured to decompose each antenna signal into filtered signals ($x_{\ell,i,k}$) issuing from the different paths (i) of the [[said]] user (k) and combining the filtered signals by scaling the filtered signals with a first plurality of coefficients ($b_{\ell,i,k}, c_{i,k}$) in order to form an estimation (z_k) of the signal transmitted by the user;

an estimator configured to estimate the contribution (($x_{\ell,k}$)ℓ=1..L) of the user to the signals received by the different antennae from the estimation of the signal transmitted and a second plurality of coefficients ($u_{i,k}$, $w_{\ell,i,k}$) obtained from the first plurality of coefficients;

said receptor configured to eliminate interference by subtracting from the antenna signals the contribution estimated the estimator in order to obtain cleaned antenna signals;

the cleaned antenna signals configured to be supplied by at least one first sequence being used as antenna signals by at least one second sequence.